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Urodynamic Evaluation of Patients With Interstitial Cystitis/Painful Bladder Syndrome

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ABSTRACT

INTRODUCTION: The purpose of the study was to determine whether or not patients diagnosed with interstitial cystitis/painful bladder syndrome (IC/PBS) had a specific urodynamic pattern that might aid in diagnosis.

METHODS: Participants were 31 women with a mean age of 32.8 years (SD= 8.2; range 22-45 years). All patients presented with storage lower urinary tract symptoms and bladder pain, pressure, or discomfort. Participants completed a 10-point visual analog scale for urgency, frequency, and pain, the O'Leary-Sant Interstitial Cystitis Symptom Index (ICSI), and the Interstitial Cystitis Problem Index (ICPI). Complete urodynamic evaluation included free flow rate, resting water cystometry, pressure-flow study, and electromyography. Primary outcome measures were the cystometric variables of first sensation to void, first desire to void, strong desire to void, and maximum cystometric capacity (MCC). Comparisons were made for patients: (1) with and without bladder pain, (2) with < 3 and ≥ 3 glomerulations, (3) with ICSI scores < 10 and ≥ 10, and (4) with ICPI scores < 9 and ≥ 9. Mann-Whitney U and *t* tests were used to compare data; significance level was $P \leq .003$.

RESULTS: Of the 31 participants, 27 (87%) had pelvic comorbidities. Mean volumes for urodynamic parameters were 57 mL for first sensation to void, 116 mL for first desire to void, 247 mL for strong desire to void, and 312 mL for MCC. A total of 25 patients (80.5%) expressed pain with filling at a mean volume of 152.5 mL. When compared with patients who did not express pain, patients with pain had significantly lower median volumes for first sensation to void ($P = .002$), first desire to void ($P = .001$), strong desire to void ($P < .001$), and MCC ($P = .001$). There were no significant differences in median volumes for any of the other comparisons. Detrusor overactivity was found in 5 patients (16%). The electromyography of the external sphincter was normal in all patients. No cases of detrusor underactivity or acontractile detrusor were detected.

CONCLUSION: Assessment of pain, pressure, or discomfort felt with bladder filling may be an important aspect of urodynamic testing for patients with IC/PBS.

Abbreviations and Acronyms

DO, detrusor overactivity
EMG, electromyography
IC, interstitial cystitis
ICPI, Interstitial Cystitis Problem Index
ICSI, Interstitial Cystitis Symptom Index
KCl, potassium chloride
LUTS, lower urinary tract symptoms
MCC, maximum cystometric capacity
PBS, painful bladder syndrome
UDT, urodynamic test
UTI, urinary tract infection

KEYWORDS: Interstitial Cystitis; Painful Bladder Syndrome; Urodynamics

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INTRODUCTION

Diagnostic criteria for interstitial cystitis/painful bladder syndrome (IC/PBS) have been proposed by several organizations. The International Continence Society [1] defined *interstitial cystitis* as a specific diagnosis that requires confirmation by typical cystoscopic and histological features. They suggested using the term *painful bladder syndrome* to describe suprapubic pain related to bladder filling that is accompanied by other symptoms such as increased daytime and nighttime frequency in the absence of other pathologic findings.

Because it is often a diagnosis of exclusion, patients with IC/PBS are frequently diagnosed years after the onset of their symptoms [2-4]. Adjunctive tests in the evaluation of patients with storage lower urinary tract symptoms (LUTS) may lead to an earlier diagnosis and facilitate treatment of IC/PBS. However, research has been inconclusive in determining the role of urodynamic studies in the diagnosis of IC/PBS; some data reveal associations between diagnostic parameters [5,6] and others do not [7,8].

The objective of the present study was to determine whether or not patients with IC/PBS had a specific urodynamic pattern that might help in diagnosis. In particular, we examined the relationship between urodynamic parameters and patient signs and symptoms, including bladder pain.

METHODS

The study was a prospective investigation that was conducted between March 2009 and April 2010. The participants were patients from Ansari Specialist Hospital, Saudi Arabia. The protocol was approved by the ethics committee of the authors' institution. All participants provided informed consent.

Participants

The participants in the study were 31 women with a mean age of 32.8 years (SD= 8.2; range 22-45 years). All of the patients presented with storage LUTS and bladder pain, pressure, or discomfort and met the inclusion and exclusion criteria that are subsequently described.

Procedures

All participants completed: (1) 10-point visual analog scales for urgency, frequency, and pain; (2) the O'Leary-Sant Interstitial Cystitis Symptom Index (ICSI); (3) the O'Leary-Sant Interstitial Cystitis Problem Index (ICPI) [9].

All patients underwent a routine urological evaluation, urinary tract ultrasonography with measurement of residual urine, and cystourethroscopy with urine cytology. These tests were conducted to exclude occult urinary tract pathology such as bladder cancer, urinary lithiasis, or anatomical infravesical obstruction that can present with symptoms similar to IC/PBS. All patients also underwent routine midstream urine analysis and culture sensitivity testing to exclude active urinary tract infection. Finally, the patients had a thorough neurological evaluation to exclude any neurological deficit affecting the lower urinary tract.

Prior to urodynamic investigation, medications that could potentially affect lower urinary tract function were discontinued whenever possible for at least 48 hours. All patients had a complete urodynamic evaluation that included: (1) measurement of free flow rate; (2) resting water cystometry at 50 mL/min; (3) pressure-flow study of micturition; and (4) electromyography (EMG) of the external urethral sphincter using anal surface (patch) electrodes. Testing was performed according the International Continence Society guidelines [1].

Cystoscopy was done under general anesthesia using a diagnostic cystoscopy 19 F sheath and bladder overdistensions. Two urologists performed the cystometry. Results from the cystoscopy and bladder overdistension were recorded as anesthetic bladder capacity, glomerulations (0-5) [10], and presence or absence of Hunner's ulcer. The biopsies done during cystoscopy and bladder overdistension were sent to the pathology lab where metachromatic staining was performed and mast cells were counted per high-powered field.

Patients were excluded if: (1) malignancy was found during cystoscopy, (2) cystoscopy was not performed for the initial diagnosis of IC/PBS, (3) questionnaires were done more than 6 months before the date of cystoscopy, (4) the patient had persistent UTI that did not respond to treatment, and (5) the patient had severe cystorectocele or genitourinary tuberculosis. The last attack of urinary tract infection (UTI) in our group of patients was 4 weeks before the start of the study, in order to exclude the effect of UTI on the urodynamic evaluation.

Data Analysis

The outcome measures were the cystometric variables of first sensation to void, first desire to void, strong desire to void, and maximum cystometric capacity (MCC). Comparisons were made for patients: (1) with and without bladder pain, (2) with < 3 and ≥ 3 glomerulations, (3) with ICSI scores < 10 and ≥ 10, and (4) with ICPI scores < 9 and ≥ 9. The presence of detrusor overactivity (DO), EMG of the external urethral sphincter, and postvoid residual urine volume were also reported.

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Table 1. Patient Symptoms and Urinary Tract Infection History (N = 31).
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Variable	n	(% N)
Pelvic comorbidities	27	87
Endometriosis	3	9.7
Vulvodynia	18	58
High-tone pelvic floor muscle dysfunction	26	84
Irritable bowel syndrome	5	16
Primary presenting complaint		
Urinary urgency	15	48
Urinary Frequency	17	55
Pain	19	61.3
History of recurrent urinary tract infection	15	48

Table 2. Filling Cystometry for Patients with IC/PBS (N=31).
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Cystometric Variable	Median	Mean	SD	Range
First sensation to void, mL	38	57	6.3	15-160
First desire to void, mL	96.5	116	8.5	15-320
Strong desire to void, mL	219	247	19.6	60-730
Maximum cystometric capacity, mL	302	312	29.5	70-870

Statistical analysis was done using unpaired *t* tests for parametric normally distributed variables and Mann-Whitney U tests for nonparametric independent data. A Bonferroni adjustment was applied because of the number of paired comparisons. A probability value was considered significant if it was ≤ .003. Data were analyzed using SPSS version 10 (IBM Corp; Somers, NY, USA).

RESULTS

Table 1 contains the pelvic comorbidities, primary presenting complaint, and number of patients with a history of recurrent UTI. Of the 31 participants, 27 (87%) had 1 or more pelvic comorbidities. The presenting complaints were rather evenly distributed among urinary urgency, urinary frequency, and pain. Finally, 48% of the patients had a history of recurrent UTI.

Table 2 contains the results of cystometry and the pressure-flow study. Mean volumes for urodynamic parameters were 57 mL for first sensation to void, 116 mL for first desire to void, 247 mL for strong desire to void, and 312 mL for MCC. There was a wide range of response for each of the variables.

When compared with patients who did not express pain, patients with pain had a significantly higher pain Likert scale (P = .002). Table 3 contains the urodynamic outcome measures for patients with and without bladder pain with filling and the probability of significant differences. A total of 25 patients (80.5%) expressed pain with filling at a mean volume of 152.5 mL. When compared with patients who did not express pain, patients with pain had significantly lower median volumes for first sensation to void (P = .002), first desire to void (P = .001), strong desire to void (P < .001), and MCC (P = .001).

Table 4 contains the urodynamic outcome measures for patients with < 3 glomerulations (n = 9) and ≥ 3 glomerulations (n = 22). The probability of significant differences is also presented. There were no significant differences in median volumes for any of the measures (P > .003).

Table 5 contains the median urodynamic outcome measures according to ICPI and ICSI scores. There were no significant differences in the median urodynamic outcome measures between patients with ICSI scores ≥ 10 and patients with lower

Table 3. Urodynamic Outcome Measures for Patients With and Without Bladder Pain With Filling; Probability of Significant Differences (N = 31).
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Cystometric Outcome Measure	Bladder Pain With Filling (n = 25)		No Bladder Pain With Filling (n = 6)		*P*
	Median	SD	Median	SD	
First sensation to void, mL	26.5	5.9	69	7.8	.002
First desire to void, mL	58	7.7	126	11.2	.001
Strong desire to void, mL	173	20.2	261	22.7	<.001
Maximum cystometric capacity, mL	221	29.5	351	28.9	.001

Table 4. Urodynamic Outcome Measures for Patients With Less Than 3 and 3 or More Glomerulations; Probability of Significant Differences (N = 31).
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Cystometric Outcome Measure	Glomerulations < 3 (n = 9)		Glomerulations ≥ 3 (n = 22)		*P*
	Median	SD	Median	SD	
First sensation to void, mL	33.5	6.1	22.5	5.6	.312
First desire to void, mL	91	8.2	68	7.3	.322
Strong desire to void, mL	244	19.8	183	18.1	.017
Maximum cystometric capacity, mL	359	30.0	272.5	27.9	.02

scores. Similarly, there were no significant differences in the median urodynamic outcome measures for patients with ICPI scores ≥ 9 and those with lower scores.

Five patients (16%) had DO. No cases of detrusor underactivity or acontractile detrusor were detected. The EMG of the external sphincter was normal in all patients. The postvoid residual urine volume estimated by ultrasound and by catheter at the end of the urodynamic study was < 50 mL in all patients.

Results of the histopathology examinations showed that there was pancystitis affecting the 3 layers of the bladder wall. In patients with nonulcerative disease (n = 12), the vesical wall was never normal. The epithelium was thinned and muscle was affected. The main features were multiple small, mucosal ruptures and suburothelial hemorrhages. Patients with ulcerative disease (n = 19) had mucosal ulceration and hemorrhage, granulation tissue, intense inflammatory infiltrate, elevated mast cell counts, and perineural infiltrates. Mast cells were more commonly seen in the detrusor muscle in patients with ulcerative IC than in patients with nonulcerative IC.

DISCUSSION

The goals of the diagnostic evaluation are to: (1) determine the source of pain (ie, whether or not it is coming from the bladder), and 2) exclude other conditions in the differential diagnosis. The current paradigm for diagnosing IC/PBS focuses largely on the symptoms of urinary frequency, urinary urgency, and pain, pressure, or discomfort with bladder filling. The final diagnosis is essentially one of exclusion of other pathologies [2,4,11].

Researchers and practitioners have questioned the best way to determine the source of pain and exclude other conditions. Some recommend cystoscopy with hydrodistention to look for the pathognomonic findings, the potassium sensitivity test, or instillation of local anesthetics into the bladder to determine whether the source of the pain is actually from the bladder [12,13]. Others simply use a detailed urological history and

Table 5. Urodynamic Outcome Measures for Patients According to Interstitial Cystitis Symptom Index and Interstitial Cystitis Problem Index Scores (N = 31).
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Cystometric Outcome Measure	ICSI Score		*P*[a]	ICPI Score		*P*[b]
	< 10 (n = 13)	≥ 10 (n = 18)		< 9 (n = 10)	≥ 9 (n = 21)	
First sensation to void, mL	36.5	24.5	.755	44.2	25.6	.006
First desire to void, mL	92.5	76	.007	97.5	82	.336
Strong desire to void, mL	259	191	.012	254.5	191.5	.011
Maximum cystometric capacity, mL	331	261	.022	330	258	.007

[a]Comparison of ICSI scores < 10 and ≥ 10.
[b]Comparison of ICPI scores < 9 and ≥ 9.
Significance at *P* < .003.

voiding diary. There is little evidence to support the optimal procedure and no diagnostic protocol that is considered a gold standard.

There are few published studies that evaluate the role of urodynamics in diagnosing IC/PBS. Studies from the 1980s reported an early first sensation on urodynamic tests (UDT) in the majority of patients with IC/PBS [5,6]. They found bladder hypersensitivity and sensory instability with pain upon filling at a mean capacity of 74 mL [6]. Kirkemo et al [14] found that first sensation to void and MCC correlated with frequency, urgency, and nocturia as measured by voiding diaries and visual analog scales. They did not find correlations between pain at screening or global measures of body pain and any urodynamic parameters. More recent studies analyzed the relationship between UDT and the intravesical potassium chloride (KCl) sensitivity test [7,8]. Neither study found a relationship between cystometric parameters and a positive KCl test. When using the KCl sensitivity test, they reported that at least 25% of patients with IC/PBS will remain undiagnosed, and a positive test may be rendered in 25% of patients with DO, 100% with acute UTI, and 100% with radiation cystitis [15]. In our study, the cystometric parameters (Table 2) were similar to those of other studies with regard to first sensation to void, first desire to void, and strong desire to void. The only exception was MCC, which was < 300 mL in previous studies [4,16] and a median of slightly more than 300 mL in our study.

In our study, pelvic comorbidities were found in 87% of cases. The frequency distribution of symptoms was similar to those in other studies [2,4]. Peters et al [2] reported that 94% of patients with IC/PBS had concomitant levator pain and more than 50% had vulvar vestibulitis. DO was found in 16% of our patients, which is within the range of 5%-18% reported in previous studies [16,17]. EMG detected no positive finding in the present study and may not be of value as a standard test in the diagnosis of IC/PBS.

In the present study, we used validated questionnaires and visual analog scales to measure frequency, urgency, and pain [9,18,19]. Our results showed that the Likert scale was a sensitive measure of urodynamic pain. However, there was no significant difference between patients with high ICSI or ICPI scores and those with low scores for the outcome measures of first sensation to void, first desire to void, strong desire to void, or MCC ($P > .003$). Some significant differences would have been found without the Bonferroni adjustment, indicating that future investigations using larger number of patients may result in different findings.

A high percentage of our patients (80.5%) expressed pain with filling. In a retrospective study, Sastry et al [12] found that only 38.3% of patients expressed pain with filling. They hypothesized that this low percentage was due, in part, to not routinely asking patients if pain was felt or not recording their responses. This may have decreased the reported number of patients who felt pain. A small number of patients is a limitation of the present study, so additional prospective studies with larger numbers of patients are needed to confirm our results. However, assessing pain with bladder filling is an important key to differentiating patients with IC/PBS with a persistent urge to void from patients with DO or overactive bladder who have urinary urgency.

The differential diagnosis of IC/PBS includes DO, urethral obstruction, urethral diverticulum, and bladder cancer. The first 2 pathologies can only be diagnosed with certainly by UDT, and urethral diverticulum may be detected on the video portion. Urodynamic evaluation provides information about IC/PBS, including: (1) the relationship between bladder filling, bladder volume, and the intensity of urge or pain; (2) the presence or absence of DO or low bladder compliance and its relationship to symptoms; and (3) urethral obstruction, which cannot be obtained by any other means [12]. Urodynamics can do all of this, so is it clinically relevant? Does it affect treatment choices and outcomes? We believe that it does. Certainly, remediable conditions such as urethral diverticulum and urethral obstruction are relevant, and symptomatic DO requires different treatment from that prescribed for IC/PBS. At this point in time, we believe that without urodynamics we may not be certain of the etiology underlying the patient's symptoms.

CONCLUSIONS

The results of the present study indicate that patients with bladder pain upon filling had significantly lower median volumes for the main urodynamic outcome measures. The assessment of pain, pressure, or discomfort felt with filling of the bladder may be an important aspect of urodynamic testing for patients with IC/PBS. EMG detected no positive finding in the present study and may not be of value as a standard test for these patients. Urodynamic study appears to aid differential diagnosis of patients and confirm symptom severity, which may influence treatment modalities. This objective test may be an important tool in the armamentarium used to diagnose IC/PBS.

Conflict of Interest: none declared.

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